RADIOLOGY AND IMAGING
OF NORMAL ADULT KIDNEY

THESIS

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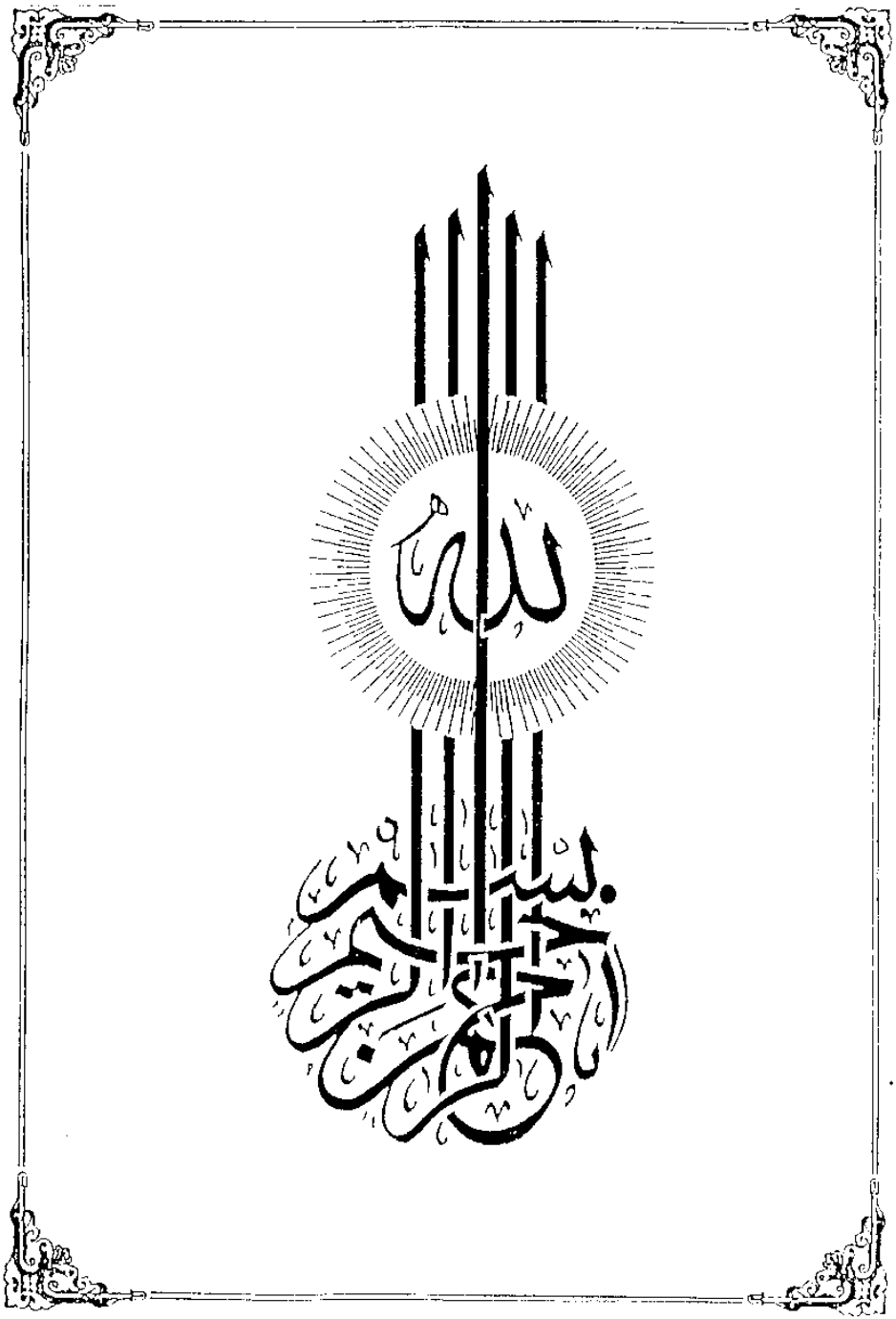

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Urinary trouble is a common complaint among Egyptian , this being true if we take into consideration the prevalance of urinary Bilharziasis being a predisposing factor to most urinary proplems .

Although the clinical picture points to the diagnosis in most cases, yet radiological and laboratory investigation form an essential part for the proper diagsis of the offending lesion and hence the best line of treatment .

Radiological assessment of kidney function and the morphologic appearance of the kidney and pelvicalyceal system form an integral part of the investigation particularly if operative management is considered . To achieve this goal , different radiographic techniques are resorted to depending upon the case .

Twenty cases of normal adult kidneys will be selected during urinary tract examination to be continuated for other methods of kidney radiological and imaging examinations .

The aim of this work is to evaluate morphology and function of normal adult kidney by different radiological and imaging modalities .

EMBRYOLOGY OF THE KIDNEY

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The kidney is composed of several units called uriniferous tubules .

The tubules arise from the mesoderm of the intermediate cell mass or nephrogenic cord which lies between the somits and the intra embryonic coelom . During their development, vertebrates have developed three kidneys .

A - PRONEPHROS : -

It is the earlist and simplest kidney to appear. It is the permanent or functioning kidney of some lower animals as the amphioxus and few fishes .

B - MESONEPHROS :-

The second kidney to appear and is more advanced in structure and function than the pronephros. It is the permanent or functioning of larval fishes and amphibian.

C - METANEPHROS :-

It is the last kidney to appear . It is avanced than the pronephros and mesonephros . It is the permanent kidney of reptils , birds and mammals .

The embryos of these animals develp at first a simple pronephros and then mesonephros and finally form the functioning metanephros .

THE METANEPHROS

It has a double origin being derived from : -

1 - Ureteric bud and its ramification .

2 - Metanephric cap : from the lower part of the nephrogenic cord .

Ureteric bud : -

It arises as a diverticulum from the dorsal and medial side of the lower part of the mesonephric duct close to the cloaca . This diverticulum extends at first dorsally and then cranially .

The ureteric bud elongates and its upper end is expanded to form the further pelvis of ureter from which arise the cranial , central and caudal tubules. From the later , arise secondary tubules and these in turn give rise to further tubules and the process is repeated . In the fifth month about twelve generations are formed while at Birth there are about twenty generations . The cranial and caudal tubules form the major calyces . The secondary tubules form the minor calyces. The tubules of the fifth order give rise to the papillary ducts . The other branchesform the straight collecting tubules of the medulla .

Development of the metanephric kidney :-

The metanephric tissue surrounding the collecting tubules becomes divided into numerous spherical masses. These masses surrounded the ends of the tubules . As new collecting tubules arise progressively, each metanphric mass becomes subdivided into several smaller masses which will form the secretory tubules .

Each mass forms one of the secretory tubules . The spherical mass becomes converted into a hollow vesicle which becomes elongated and S shaped in appearance . One end joins the collecting tubules and the other blind end of the tubule forms the Bowman's capsule.

Further growth of the tubule leads to the formation of distal and proximal convoluted tubules . The remaining portion of the tubules forming the loop of Henele .

The first group of secretory tubules to appear are temporary and they degenerate . Any increase in kidney size after birth results from enlargment of the tubules already present . The human kidney is capable of secretion in the third month of foetal life . Since the placenta acts as an excretory organ , the renal function is either minimal or nil .

(CHARLES.W.BODEMER 1970)

Shape of the kidney :

In early stages the kidney is a lobulted organ , later these groves disappear and the surface of the kidney becomes smooth . Lobulation is permanent feature in some animals and birds .

Migration of the kidney :

In early stages the kidney lies in the pelvic region . Later it migrates upwards till it lies in front of the upper part of the posterior abdominal wall .

Changes of blood supply of the kidney :-

During its migration , the kidney changes its blood supply . At first it recieves its blood supply from the median sacral , the common iliac and then from the lower part of the abdominal aorta . Accessory renal arteries may occur , they may enter at the hilum or at the upper or lower poles of the kidney .

Rotation of the kidney :-

At first the convex border of the kidney is directed posteriorly while the hilum lies ventrally . Later the kidney rotates about 90 degree and the dorsal convex border becomes lateral .

(Harry wang 1972)

ANATOMY OF THE KIDNEY

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The kidneys are paired, retroperitoneal, bean shaped organs lying on each side of the vertebral column . Usually, the Rt. kidney is slightly lower than the left one due to the presence of the liver.

The upper pole is approximately 4 cm closer to the mid line than the lower pole, so the kidneys lie in an oblique position.

The kidneys lie on the upper part of the posterior abdominal wall opposite the bodies of the T_{12} and L_{1}, 2, 3, vertebrae . (DAVIS 1967)

Each kidney has a vertical slit in its medial border which is called the hilum . Through the hilum the renal artery entersthe kidney and the renal vein and the ureter leave it .

The transpyloric plane psses through the hilum of each kidney .

There are differences between the position of the two kidneys which are : -

1 . The Rt. kidney is ½ inch lower in position than the left one .

2 . The upper end of the left kidney extends upwards as high as the vertebral end of the 11th rib.

3 . The upper end of the Rt. Kidney does not reach higher than the upper border of the 11 [illegible] rib or maximally 11 th intercostal space .

4 . The lower end of the Rt. Kidney extends downwards as to lie 1 ½ inches above the iliac [illegible] lower end of the 3 rd lumber vertebrae)

5 . The lower end of Lt. Kidney lies [illegible] above the iliac crest . ([illegible] AND [illegible] 19[illegible])

From behind , the kidney lies [illegible] rectangle which is drown by 2 horizontal [illegible] two vertical lines :-

1 . The upper horizontal line is opposite the spine of T_{11}

2 . The lower horizontal line is opposite the spine of L_3 .

3 . The 2 vertical lines are drown one inch and three inches from the median plane ([illegible] 1962

The hilum of the Rt. kidney is opposite [illegible] lumber vertebrae and the Lt. Kidney is 1 - [illegible] higher In maximum move ment , it is about 5 cm or 1 ½ vertebral body occurs in change from recumbent to erect

position and during respiration .

The Lt. kidney is longer and narrower than the Rt. one . (DR. SMITH 1961)

Measurment of the Kidney :

Length	12	cm
Width	6	cm
Thickness	3	cm

(GRAY 1958)

Each kidney has :

1 . Two borders (lateral and medial)

2 . Two surfaces (anterior and posterior)

3 . Two ends or poles (upper and lower)

The lateral border is convex while the medial border is concave and contain the hilum .

The lateral border is regular and smooth.

The hilum contains the renal artery , renal vein and the pelvis of the ureter which are arranged in the following order : -

I . The renal vein lies in the front.

2 . The renal artery lies in the middle

3 . The pelvis of the ureter lies behind .

(ELKIN 1980)